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Key competences of design-build clients in China

Abstract

Purpose-- DB clients play a vital role in the delivery of DB system and the clients' competences are critical to the success of DB projects. Most of DB clients, however, remain inexperienced with the DB system. This study, therefore, aims to identify the key competences that DB clients should possess to ensure the success of DB projects in the construction market of China.

Design/Methodology/Approach -- Five semi-structured face-to-face interviews and two rounds Delphi questionnaire survey were conducted in the construction market of China to identify the key competences of DB clients. Rankings have been assigned to these key competences on the basis of their relative importance.

Findings-- Six ranked key competences of DB clients have been identified, which are, namely, (1) the ability to clearly define project scope and objectives; (2) financial capacity for the projects; (3) capacity in contract management; (4) adequate staff or consulting team; (5) effective coordination with DB contractors and (6) experience with similar design-build projects. Calculation of Kendall's Coefficient of Concordance (W) indicates a statistically significant consensus of panel experts on these top six key competences.

Practical implications—Clients should clearly understand the competence requirements in DB projects and should assess their DB capability before going for the DB option.

Originality/Value-- The examination of DB client's key competences will help the client deepen the understanding of the DB system. DB clients can also make use of the research findings as guidelines to improve their DB competence.

Key words: Design-build; Client; Competence; Delphi method; China

Paper type: Research paper

Introduction

Design-build (DB) is a delivery method in which the design-builder is contractually responsible for both design and construction works (Songer *et al.*, 1997). It has been demonstrated to be an effective delivery method and has gained popularity overseas in the recent years. DB system provides clients with a number of advantages such as single-point responsibility, time saving, enhanced financial certainty, reduced disputes and increased productivity (Konchar and Sanvido, 1998; Hale *et al.*, 2009). At the same time however, the clients are also required to possess certain competences in order to conduct the DB projects successfully. For example, the clients should be very clear about the project scope and expected outcomes, and provide firm performance specifications rather than descriptive specifications at the early stage.

Many researchers and practitioners have discovered that the client's competences are critical to the success of DB projects. Songer and Molenaar (1997) indicate that client's competence is one of critical factors for successful public-sector DB projects. Mo and Ng (1997)'s survey shows that the architects and builders in Hong Kong view client's experience as critical to the DB project success. Molenaar and Songer (1998) relate client's capabilities to the success in the selection of public sector DB project. Leung (1999) and Chan *et al.* (2001) find that client's competences were important to bring successful DB project outcome. Quatman (2003) even asserts that the success of DB projects depends on the owner's abilities and attitudes. Ling (2004) uses neural network to predict performance of DB projects in Singapore and discovered that key variables affecting project performance may be attributed to both contractors and clients. Lam *et al.* (2008) identified the competency of client as one of the success factors for DB projects. All these studies reflect that DB clients play a vital role in the delivery of DB projects.

In the construction market of the PRC, many clients lack the adequate competences to conduct DB projects successfully. Currently, only less than 10 percent of the construction projects are delivered in DB method (China Construction Industry Association, "CCIA",

2006), and most of the clients remained inexperienced with DB system. Moreover, many clients still keep traditional perspectives to the DB system. For example, the clients try to transfer most of the traditional risks such as the design errors to DB contractors while leaving very limited room for the design-builder's design input. This will give rise to interest conflicts and misunderstandings between clients and DB contractors.

Therefore, this study aims to identify the key competences that the client should possess to ensure the success of DB projects in the construction market of the PRC. A literature review on required competences of DB clients was undertaken. Then semi-structured face-to-face interviews with five experts in the construction industry were conducted to solicit their views on the potential key competences of DB clients in the construction market of China. Finally, a two-round Delphi questionnaire survey was carried out with another group of twenty experts to identify the key competences of DB clients. It is expected that this study will provide clients with measures to evaluate their DB competences and further enrich their knowledge of the DB system.

Literature review

The client's competences can have significant effects upon the achievement of project performance (NEDO, 1974). Cleland (1994) suggested that project success is dependent on the client's effectiveness in defining and formulating the project. Kerzner (1995) identified that the client organization can have a great deal of influence on project success. Lim and Ling (2002) found that clients' financial status, characteristics, management competency and construction experience can have significant effects upon the attainment of project success.

In DB projects, even though clients can leave most of the project responsibilities to DB contractors, they are still required to possess certain competences to ensure the success of DB projects. For example, in DB projects, the contractor develops the design according to the client's brief. The client should, therefore, be able to brief his requirements in

writing and be prepared to take an active role in the construction process to avoid a gap between the requirements of the client and other project team members (Kometa et al., 1995). The overall contribution of the DB client to the project is indeed necessary.

Several major studies have identified a list of competences of DB clients that contribute to the success of DB projects. These capabilities do not necessarily constitute the key competences of DB clients, but may serve as the potential sources in the DB market of China. Songer and Molenaar (1997) identified 15 primary project characteristics that affect the success of public-sector DB projects. Among the 15 characteristics, the owners are required to (1) have a precise understanding of the project scope; (2) have the ability to precisely define the project scope; (3) have adequate staff dedicated to the project. Besides these competences, the owner should prefer to shift some of the traditional risk to the contractor and be willing to give up a large amount of the design input after design-builder selection. One year later, Molenaar and Songer (1998) set up a selection model for public sector DB project. Among all the prediction variables contributing to the success of DB projects, the requirements and capabilities of owner include: (1) owner/agency experiences, and (2) owner/agency staffing. The owners are required to have DB related experiences and adequate staff to answer design and construction related questions. The owners must also convey the parameters of the project to the design-builder in the form of a detailed contract document or a simple request for proposal.

Chan et al. (2001) conducted multiple regression analysis and found project teams commitment, client's competence, and contractor's competence were important to bring successful project outcome. The client's competencies include: (1) a good capability of managing DB project; (2) a precise understanding of the DB project scope before it was submitted to the contractor; (3) clear articulation of end-user's needs.

Ling and Liu (2004) used artificial neural network (ANN) technique to construct the models to predict DB project performance. To ensure project success, client and his consultants should have (1) adequate staffing level to attend to contractor, (2) experience with similar construction projects, and (3) experience of DB projects. It is also

recommended that the owners and their consultants well manage the project-related factors such as tender selection criteria, project scope, and form of contract to have higher chance of success.

Lam et al. (2008) investigated the determinants of successful design-build projects in Hong Kong using multiple regression analysis. The results shown that the competency of client or his representative is the most important success factor, which include (1) project management skills, (2) client and end-user's active involvement in the project, (3) commitment and adaptability of client's representative, (4) decision-making power, (5) DB experience and capability, and (6) technical skills.

Various competences of DB clients have been stressed by different researchers. A summary of these suggested competences is presented in Table 1.

Table 1 Summary of required competences of client

Authors	The competences of DB clients
Songer and Molenaar (1997)	The owner should have a precise understanding of the project scope; the ability to precise define the project scope; adequate staff dedicated to the project.
Mo and Ng (1997)	The owner should have the ability to develop a high-quality client brief, and have the design-build experience
Molenaar and Songer (1998)	The owner should clearly define the project scope, have the DB related experience; construction sophistication and sufficient staff
Pearson and Skues (1999)	The client has the abilities to develop clear definition of project scope, owner's requirements and client's brief; mange the design process and design changes
Leung (1999)	The client has the ability to clearly define the project scope; have comprehensive employer's requirement; thoroughly assess the bidder's qualification and technical proposal
Chan et al. (2001)	The client had a good capability of managing DB project; a precise understanding of the DB project scope; and clearly articulated end-user's needs
Ling and Liu (2004)	The client should have a high level of construction sophistication and construction experience, and have handled DB projects in the past
Lam et al. (2004)	The client should be able to brief his requirements in writing; take an active role in the construction process; has the DB experience; have skilled team members.
Lam et al. (2008)	The client or his representative has the project management skills, technical skills, active involvement in the project, decision-making power, and DB experience and capability.

Research Methods

The research methods employed in this paper included: (1) semi-structured face-to-face interviews, (2) content analysis, and (3) Delphi questionnaire survey. The semi-structured interviews with a sample of five individual experts and a content analysis were conducted to identify a list of potential competences of DB clients in the PRC construction market. After the consolidation of these key competences, two rounds of Delphi questionnaire survey were undertaken with another group of twenty individual experts to assess the appropriateness of the proposed competences, and to prioritize these competences by rating them against their level of importance based on a ten-point Likert scales.

In the semi-structured face-to-face interviews, all the experts have sufficient DB knowledge, and extensive rich hands-on DB experience. They were interviewed to answer the following open-ended questions:

- 1. What are the key competences of design-build clients in the construction market of the People's Republic of China?*
- 2. Why are these key competences important to the success of DB projects?*

Face-to-face interviews were adopted because of the synchronous communication in time and place. They offer the possibility of dispelling ambiguity because the interviewer will be next to the interviewee as the questions are being answered (Opdenakker, 2006). Another main reason of conducting face-to-face interviews lies in the quality of the data obtained. Since the DB system has not been commonly used in the People's Republic of China, the competencies identified in the literature review may not be suitable in the construction market of China. As a result, the mail survey response may suffer from the depth of coverage of this topic in response to an open-ended question. The depth and clarification of responses from face-to-face interviews usually provides data better than those obtained from self-completion methods (Ayidiya and McClendon, 1990). Data and valuable information often rely on the minds, attitudes, feelings or reactions of the

respondents. After conducting the semi-structured face-to-face interviews, a content analysis was then employed to categorize the key competences of DB clients. Weber (1990) stated that content analysis could help classify textual material, reducing it to more relevant, manageable bits of data. It is often used to determine the major facets of a set of data, by simply counting the number of times an activity happens, or a topic is depicted (Fellows and Liu, 2008). After employing the content analysis, a total of six key competences of DB clients were formulated and consolidated for further analysis.

After the consolidation of six key competences of DB clients, a two-round Delphi questionnaire survey was conducted to evaluate and prioritize these competences. The Delphi method is best suited in fields that have no adequate historical data for the use of other methods (Martino, 1973). It is particularly appropriate when the problem does not lend itself to the precise analytical techniques but can benefit from subjective judgment on a collective basis (Linstone and Turoff, 1975). Even if these collective judgments of experts are made up of subjective opinions, it is considered to be more reliable than individual statements. (Masini 1993). As a result, it can extract the maximum amount of unbiased information from a panel of experts (Chan *et al.*, 2001). Considering the immaturity of DB market in China, the Delphi technique will serve as an appropriate consensus-reaching method for the research topic in this paper.

The Delphi method typically involves the selection of suitable experts, development of appropriate questions to be put to them and analysis of their answers (Cabaniss, 2002, Outhred, 2001). The original Delphi procedures have three features: (1) anonymous response; (2) iteration and controlled feedback; and (3) statistical group responses (Adnan and Morledge, 2003). The features are designed to minimize the biasing effects of dominant individuals, irrelevant communications, and group pressure toward conformity.

The Delphi method used in this research was composed of two rounds with 20 experts. All the experts have sufficient DB experience and knowledge (most of them take senior management positions in the relevant organizations). In Round 1 of the Delphi

questionnaire, the respondents were asked to provide ratings against the levels of importance on each of proposed competences of DB clients, based on a ten-point Likert scales. Seventeen experts completed the Round 1 of the Delphi questionnaire survey. In Round 2 of the Delphi questionnaire, respondents were asked to reconsider the ratings of each competence in the light of the consolidated results from Round 1. Finally, 16 experts completed the round 2 of the Delphi questionnaire survey. The questionnaires in each round are as follows:

Questionnaire1: Please give ratings to the key competences of design-build clients according to their importance.

Questionnaire2: Please re-rate the key competences of DB clients in the light of the results from Round 1.

The majority of Delphi studies have used 15-20 respondents (Ludwig, 2001). Moreover, with a homogeneous group of experts, good results can be obtained even with a panel as small as 10-15 individuals (Ziglio, 1996). Therefore, the opinions solicited from the 16 experts in the second round of the Delphi questionnaire survey are considered adequate to provide reliable results.

Analysis of Semi-structured Face-to-face Interviews

Although many studies have identified a variety of DB clients' competencies (some of which have been highlighted in Table 1), given the unique situation of the DB markets around the world, the key competences of DB clients in China will probably be different from those identified in other locations. To identify the specific key competences of DB clients in China, a thorough investigation with interviewees who satisfy the following selection criteria is considered necessary:

- (1) The expert should have sufficient DB experience;
- (2) The expert should have extensive DB knowledge;
- (3) The expert should have taken senior management position in his or her organization.

Twelve potential experts were identified to have met all the selection criteria. Invitations through emails were sent to these experts to explore their availability to participate in the face-to-face interviews. The invitation email was supported with materials including the research background, the proposed interview questions, and the identified capabilities of DB clients (shown in Table 1). These materials provide them a clear understanding of the purpose of the study and the extent of participation to be expected. Finally, five experts agreed to participate in the face-to-face interviews.

The five interviewees selected are leading industrial practitioners in the DB fields. Table 2 shows that all of them have rich hands-on experiences in the DB market, hold senior management positions in their organizations and have been involved in the research activities in DB.

Table 2 Background information of the interviewees

	Affiliation	Job position	Years of DB experience	Research experience in DB
Expert A	Construction Department in State Government	Deputy Director	12	Yes
Expert B	Top University in China	Head of the Institution	18	Yes
Expert C	Large Private Project Management Firm	Head of Department	9	Yes
Expert D	Large Private Real Estate Developer	Deputy Manager	7	Yes
Expert E	Large-scale State-owned Construction Company	Deputy Chief Engineer	10	Yes

The interviews were conducted in a semi-structured manner. The semi-structured interview is a technique used to collect qualitative data by setting up a situation (the interview) that enables an interviewee to express their opinions on a particular subject. Open-ended questions were used to understand the interviewees' point of view (What are the key competences of DB clients in China? Why do you think they are important?)

After conducting the semi-structured face-to-face interviews, content analysis was used to identify the key competences of DB clients in China. The first step to conduct content analysis is to identify the materials to be analysed. The second step is to determine the form of content analysis to be used, which includes qualitative or quantitative. The choice is dependent on the nature of the research project. The choice of categories will also depend on the issues to be addressed in the research if they are known. In qualitative content analysis, emphasis is on determining the meaning of the data (i.e. grouping data into categories). Quantitative content analysis extends the approach of the qualitative form to generate numerical values of the categorized data (frequencies, ratings, ranking, etc) which may be subject to statistical analyses. Comparisons can be made and hierarchies of categories can be examined (Fellows and Liu, 2008). The process in conducting the content analysis at this research stage was that all the key points and main ideas of each interview verbatim transcript were first marked down. Then, similar main points and ideas were assembled and different main themes were finally crystallized from the analysed interview transcripts. After the analysis, a total of six main themes of the key competences of DB clients were categorized, including: (1) ability to develop clear project scope and objectives, (2) experience with similar DB projects, (3) sufficient staff or consulting team devoting to the DB project, (4) ability in contract management, (5) ability to coordinate effectively with design-builders, and (6) financial ability to provide sustained capital supply for the DB project. Finally, the identified key competences were verified and validated by the interviewees. Table 3 shows the six consolidated key competences of DB clients as proposed by the five interviewees.

Table 3 Summary of key competences of DB clients in the construction market of China

Perceived competences of DB clients	Expert A	Expert B	Expert C	Expert D	Expert E
1. Ability to clearly define project scopes & objectives	✓	✓	✓	✓	
2. Experience with similar DB projects	✓	✓			✓
3. Sufficient staff or consulting team				✓	✓
4. Ability in contract management			✓		✓
5. Effective coordination with DB contractor	✓				
6. Financial capability for DB projects	✓	✓	✓	✓	✓

Two Rounds of Delphi Questionnaire: Results and Analysis

Selection of expert panel

One of the most important considerations when carrying out Delphi study is the identification and selection of potential members to constitute the panel of experts (Ludwig, 2001; Stone and Busby, 1996). The selection of members or panelists is important because the validity of the study is directly related to this selection process. In this Delphi survey, the researchers attempted to identify panelists who meet all the following selection criteria:

- (1) Having sufficient working experience or knowledge in the DB field,
- (2) Working in relevant organizations in the construction industry,
- (3) Holding senior management positions in their organizations

Finally, 20 experts who meet the selection requirements agreed to participate in the Delphi survey. A list of the panel members and their affiliations are shown in Table 4.

Table 4 List of the panel of experts for the Delphi study

Type of firm / department	Number
Real estate developer	1
Government department	3
Design consultant company	3
Project management company	3
University	4
Construction company	6
Total	20

The selected experts represent a wide spectrum of construction professionals in the PRC and provide a balanced view for the Delphi study. All the experts have sufficient

experience and expertise in DB projects; Table 5 shows the respondent classification by years working in the construction industry and in DB field.

Table 5 Respondent classification by years working in construction industry and DB field

Years	In construction industry	In Design-build field
0-5	5%	15%
5-10	30%	50%
10-20	30%	30%
20+	35%	5%
Average (Years)	15	9

Furthermore, all of the experts hold senior management positions in their organizations. They have sound knowledge about the DB market in China. Table 6 shows the respondents' job positions/titles.

Table 6 the job positions of the panel experts

Job position	Number
Chief engineer	1
Deputy chief engineer	2
Deputy general manager	2
Project manager	3
General director	1
Project management director	1
Academic	2
Engineer	2
Project management consultant	2
Director of research institute	2
Deputy division chief in government	2
Total	20

The sufficient working experience, sound knowledge about the domestic DB market, and relevant organizations of the selected experts ensure the validity of this Delphi research.

Round 1 of the Delphi questionnaire survey: Ratings obtained from the experts

In the first round of the Delphi questionnaire survey, the panel experts were requested to assess the importance of each of the six short-listed competences of DB clients. A 10-

point Likert Scale was used. Although the 1-10 ordinal scale is not as frequently used as the 1-7 or 1-5 scale system in Delphi study, it is much more familiar to the Chinese construction experts. If a score is lower than 6 points, it is commonly regarded as failing to pass the threshold of importance evaluation. Therefore, in this research, a mean score of 6 becomes a cut-off point and only the criteria whose mean score is 6.0 points or above will be re-evaluated in the next round. Finally, 17 experts completed the questionnaire in late April 2008.

A statistical analysis was performed on the 17 replied questionnaires received in which the mean ratings for the identified six competences of DB clients were computed (Table 7). To measure the degree of agreement between the panel members on the ordered list of the six key competences, the Kendall's Coefficient of Concordance (W) was calculated with the aid of the SPSS software. The Kendall's Coefficient of Concordance indicates the degree of agreement between the panel members on the ordered list by mean ranks by taking into account the variations between the rankings (Doke and Swanson, 1995). Table 7 also shows that Kendall's Coefficient of Concordance for the rankings of the six competences of DB contractors was 0.144, which was statistically significant at 3% significance level. The null hypothesis that the respondent's ratings within the group are unrelated to each other would have to be rejected. Therefore, it can be concluded that a significant amount of agreement among the respondents within the group of panel experts is found.

Table 7 Result of round 1 questionnaire—the required competence of the client

The required competence of the client	Mean	Rank
Ability to clearly define project scope and objectives	8.88	1
Financial capacity for the projects	8.41	2
Capacity in contract management	8.06	3
Sufficient staff or consulting team	7.88	4
Effective coordination with DB contractors	7.70	5
Experience with similar design-build projects	7.41	6

Number (n) =17.

Kendall's Coefficient of Concordance (W) =0.144

Level of significance=0.032

Table 8 shows the correlation matrix for the data set. It reveals that the six client's

competences are not highly correlated with each other at 5% significance level (most of them are even insignificantly correlated with each other). In addition, it is unlikely to have any multiplier effect between them. This provides an adequate basis for proceeding to the next round of Delphi survey on these competences. Finally, all the six competences were included in the second round Delphi survey to obtain the final key competences of DB clients.

Table 8 Correlations matrix among the seven complexity measures

	Clear scope & objectives	Financial capability	Contract management	Sufficient staff	Effective coordination	DB experience
Clear project scope	1	.096	.133	.176	-.309	-.300
Financial capability		1	.264	-.096	.356	-.192
Contract management			1	-.279	.295	-.235
Sufficient staff				1	.172	.481
Effective coordination					1	.561*
Design-build experience						1

Notes: * Correlation is significant at the 0.05 level (2-tailed).

Round 2 of the Delphi questionnaire: Re-assessing the Ratings

In Round 2 of the Delphi survey, the experts were asked to re-assess their ratings in the light of the consolidated results obtained in Round 1. The Round 2 of the Delphi questionnaires were distributed to the same group of panel experts by email in late April 2008. Finally, 16 experts completed the questionnaire in late May 2008.

Most experts had reconsidered their ratings provided in the previous round and had made adjustments to their ratings. However, Table 9 shows that the rankings of all competences remain unchanged when compared with the consolidated results in Round 1. The Kendall's Coefficient of Concordance (W) for the rankings of these variables is also provided in Table 9. The increased value of Kendall's Coefficient of Concordance means that the agreement among the panel experts has improved.

Table 9 Result of round 2 of Delphi questionnaire survey--key competences of DB clients

The required competence of the client	Mean	Rank
Ability to clearly define project scope and requirements	8.97	1

Financial capacity for the projects	8.41	2
Capacity in contract management	8.16	3
Adequate staff or consulting team	8.03	4
Effective coordination with contractor	7.72	5
Experience with similar design-build projects	7.50	6

Number (n) =16.

Kendall's Coefficient of Concordance (W) =0.243,

Level of significance=0.002

The correlation matrix as indicated in Table 10 manifests that the six key competences of DB clients are not highly correlated with each other at 5% significance level (all of them are insignificantly correlated with each other). In addition, it is unlikely to have any multiplier effect between them. Finally, the six competences are adopted as the key indicators for the DB clients' competences.

Table 10 Correlations matrix among the six key competences of DB clients

	Clear scope & objectives	Financial capability	Contract management	Sufficient staff	Effective coordination	DB experience
Clear project scope	1	-.101	.231	.135	-.301	-.419
Financial capability		1	.383	.004	.587*	-.052
Contract management			1	-.132	.497	-.089
Sufficient staff				1	.032	.259
Effective coordination					1	.501*
Design-build experience						1

Notes: * Correlation is significant at the 0.05 level (2-tailed).

Discussions on key competences of DB clients

The final outcome of this paper was the identification of six key competences of design-build clients in the construction market of the People's Republic of China. In order to ensure the success of DB projects, DB clients should, in particular, have clear project scope and objectives, sufficient financial capability and adequate contract management ability. It should be added that the Delphi method by its inherent nature serves as a self-validating mechanism because individual experts are given chances to re-assess their scores with reference to the consolidated mean scores as assessed by other experts. By using the Delphi method, the maximum amount of unbiased and objective information can be obtained from the panel of experts.

Clear project scope and objectives

The competence to develop clearly articulated project scope, objectives and requirements in the brief, is regarded as the mostly required competence of the DB clients. Developing a clear scope of DB projects involves understanding the requirements and objectives for completed projects in both function and performance terms (Gransberg et al., 2006). Proper scope definition has proven to be a primary determinant of project success in traditional delivery method, and it is regarded as even more important in design-build projects (Songer and Molenaar, 1997). Quatman (2003) believes that a project's success depends on the owner's abilities and attitudes. If the owner is very clear about the project's goals, scope, and expected outcome, then the DB system will work to the owner's benefits. The client's objectives/requirements need to be established in advance of the procurement selection; otherwise it can be very costly if the information provided by the owner to the contractor at the outset of the design build process is error (Mogibel, 1999).

Financial capability

The client plays important roles in contributing to DB project success. Besides having a clear definition of DB projects, the clients in the PRC are particularly required to have a strong financial capacity for the project. Beard et al. (2001) pointed out that a fundamental duty of any construction client is to meet its financial obligations on the projects. It is particular true in DB projects because the projects are usually delivered on a fast-track basis and clients may be relying heavily on estimates until final pricing information is obtained. Therefore, clients should provide the evidence to design-builders that they have sufficient funding to meet their commitments. In China, the DB system is usually applied in large and complex public projects, which require large capital scale accordingly. When clients transfer most of the risk to the DB contractors, they are specially required to provide sustained capital supply for the DB projects. Otherwise the DB contractor will demand higher contract price to compensate the extra risk or even

reject the opportunity to bid

Contract management ability

To the clients, managing the DB contract and monitoring the performance of the DB contractor is crucial to achieving the intended objectives of the procurement. During the process of DB contract management, the clients should carefully negotiate the terms and conditions of contracts with the DB contractor and monitor the performance of design-builder to ensure the contracted projects are provided in accordance with the specification and terms of the contract. In addition, the clients should also document and agree any changes that may arise during its implementation or execution of contract. Although the administrative burden will be greatly reduced in the DB projects, the clients should possess the ability to effectively manage the DB contract to achieve the intended project objectives.

Sufficient staff

Although DB clients can leave most of the responsibilities to design-builders, clients are still required to have sufficient staff devoted to DB projects. At the early project stage, client is required to have sufficient staff resources to fully define the project, and prepare specifications for the bidding job. After the DB contractor is selected, the client should also have adequately sized staff devoted to answer the design-related and construction-related questions. If the clients do not have the in-house staff for the DB projects, out-source adviser or design consultant should be employed. Otherwise, with the same firm designing and building the project, there may not be an independent party providing the necessary service to protect the owner, in particular in the immature DB market of the PRC.

Effective coordination ability

Effective communication between client and contractor is critical to the successful of the

design-build project (Ng and Aminah, 2006). The design-build system provides the client and contractor an opportunity to interact more often and more directly than traditional contract. To the client, it is especially important to conduct effective coordination with contractor to avoid misunderstanding or conflicts occurred during the process stage of the project. In DB projects, the design documents are often preliminary at the early stage and usually change over the course of the project. Therefore, clients should develop a system for processing change orders and claims through effective coordination with design-builders. In addition, a lot of decisions will be made during the execution of DB projects. This requires close communication between clients and contractors. Developing and maintaining good relationships will bring additional benefits for both parties.

DB related experience

Many studies indicated that DB projects would be more likely to be successful if the clients have the similar design-build experience (Mo and Ng, 1997, Molenaar and Songer, 1998; Ling and Liu, 2004). Even though most of the clients remain inexperienced with DB system in the PRC, it will be much easier to conduct the DB system if the clients have sophisticated design ability and general construction experience in the past. To the inexperienced DB clients in the PRC construction market, selecting the DB delivery system does not mean that they can simply leave all the project and responsibility to the DB contractor. They should possess the design and/or construction experiences to ensure the smooth delivery of DB projects. Otherwise, experienced design consultants or advisers should be employed at initial stage of the DB projects.

Significance, limitation of the study and future work

The key competences identified generally confirm the capabilities obtained from the literature review. Although more and more clients are attracted to the DB system because it speeds project completion, reduce cost, and creates a single point of responsibility, DB clients should possess these key competences in order to ensure the success of DB

projects. The research findings can be used as guidelines for DB clients to improve their DB competences.

However, it is worth noting that some of the identified competences are still broad and vague concepts (such as the coordination ability). Different assessors may have their own semantic interpretation on each competence. Thus it is desirable to identify suitable quantitative interpretations/indicators for each competence and provides objective evaluation results based on quantitative evidence in the future. In addition, similar to any other opinion-based research study, this research study suffer from subjectivity, bias, imprecise definition, and human inability to process complex information. However, the effects of these limitations can be further reduced by taking a larger sample size in the face-to-face interviews and the Delphi questionnaire survey.

Further research could be conducted to set up a comprehensive model to evaluate the client's overall DB competence based on the research findings. In the DB competence model, the competence of DB clients is defined by two components: the weighting coefficient and the competence rating scores. The weighting coefficient describes the contribution/importance of the six competence factors. The rating system help determine the values of the six competences for DB clients. This evaluation model will be of great help for DB clients to assess their DB competence before resorting to DB system to deliver their projects. In addition, since the key competences of DB clients were identified in the construction market of the People's Republic of China, further research should be also conducted in other geographical locations to find out their similarities and differences for international comparisons.

Conclusions

Six key competences of DB clients in the construction industry of the People's Republic of China have been identified in this study through a comprehensive literature review, five semi-structured face-to-face interviews, and a two-round Delphi survey. The findings

indicate that DB clients should possess the ability to clearly define project scope and objectives, financial capability for DB projects, capability in contract management, sufficient staff or consultant teams, effective coordination with design-builders, and experience with similar DB projects to ensure the success of DB projects. The results confirm the specific conditions of the DB market in the People's Republic of China.

The research findings of this study provide some practical implications, especially for the inexperienced DB clients. The clear articulation of project scope is the most important competence of DB clients. Even though the clients can leave most of the project to design-builders, they should have clear understanding of DB projects at the very beginning. Otherwise, they may not get the final projects as required. Therefore, it is very important and necessary for clients to employ the experienced consultant teams to provide project definition, performance specifications if the in-house resources are not available.

The research findings of this study also imply that the key competences of DB clients would vary in different conditions of DB markets. For instance, in the Chinese construction market, because many design-builders still lack sufficient DB experience, the client's ability to coordinate effectively with design-builders is regarded as one of the key competences of DB clients. Further research should, therefore, be conducted in other geographical locations to find out their similarities and differences for international comparisons. Furthermore, it should be noted that the key competences and their rankings will likely change over time as the DB market matures in China.

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